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A COMPARISON OF THE MORE IMPORTANT STRUCTURAL DETAILS OF THE LARVA OF THE ARCHAIC TANYDERID DIPTERON PROTOPLASA FITCHII WITH OTHER HOLOMETABOLA FROM THE STANDPOINT OF PHYLOGENY.

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In Vol. 55, p. 221, of the Proceedings of the Linnean Society of New South Wales, for 1930, Dr. C. P. Alexander has given an excellent general account of the immature stages of the Tanyderid Dipteron *Protoplasa fitchii* O. S., and to his general description of the larva, I would add the following details from a *Protoplasa* larva captured by me during an expedition to the Gaspé Peninsula, Quebec, undertaken by Dr. Alexander and myself, in the hope of obtaining the hitherto unknown immature stages of the Tanyderidae in the region where I had formerly encountered swarms of the rare and primitive *Protoplasa* (Can. Ent., 1929, Vol. 61, p. 70).

We had expected that the larva of *Protoplasa* would be an extraordinary looking creature like the supposed larva of this insect figured in Dr. Alexander's " Craneflies of New York"; but when we finally found the larvae of *Protoplasa* on June 19, 1929, in the shallow waters of the west branch of the Pabos River, two or three miles west of the town of Chandler, Quebec, they turned out to be very *Chironomus*-like, small, slender creatures, about 17 mm. long and 1.5 mm. broad, eucephalous, with brown heads and pale bodies, amphipneustic (but with the posterior spiracles on the *sides* of the eighth abdominal segment), with a pair of posterior " pseudopods," and with slender posterior gills instead of an anal breathing tube (like that of the supposed larva of *Protoplasa*).

The larvae were found in the sand and gravel of the shallower waters (a few inches deep) a couple of feet from the shores of the west bank of the Pabos River, a few yards above the old wooden bridge over the West Pabos River, which is about 120 feet wide at this point. The stream was very sluggish, and workmen who were repairing the old wooden bridge which had been broken by the weight of a heavy automobile, informed us that the water of the river was affected by the tides of the Bay of Chaleur, a few miles away, but the river water was perfectly fresh to the taste, and I could detect no difference in the level of the water of the river during the hours we spent in searching for the larvae of *Protoplasa.*

The *Protoplasa* larvae were so extremely small and difficult to detect, that as soon as I had captured one specimen for study, after hours of back-breaking work under a broiling sun, and amid swarms of pestilential " black flies " and " punkies " which gave us no peace, I gave up the discouraging search for more specimens; but Dr. Alexander persisted in the search until he had obtained about eight larvae, two of which were allowed to pupate (see description of the pupae by Alexander, 1930, l. c., with added details given by me in Vol. 32, p. 83, of the Proceedings of the Entomological Society of Washington for 1930). Before distributing his material to various museums, etc., Dr. Alexander gave me two more larvae for comparison with my specimen, and very kindly allowed me to make the sketches of a very large and well sclerotized larva from which Figures 6, 13 and 21 were made, before this specimen was sent away. Unfortunately, all of the specimens in my possession have the body so bent that the under surface of the head capsule is not visible for study, and since I do not wish to injure the valuable specimens by dissecting them at this time, I shall confine my remarks to such of the structural details as were visible in the larva from which the sketches were made.

In its general features, the type of head-capsule exhibited by *Protoplasa* (see Fig. 13) is the most primitive one that I have been able to find among the larvae of the Diptera, although in some respects the head of a larval Bibionid (see Fig. 31) is extremely primitive also, and in such features as the occurrence of peripneustic spiracles, etc., a Bibionid larva is even more primitive than an amphipneustic *Protoplasa* larva. The Bibionid larva, however (Fig. 31), has reduced antennae (like those of some Trichopterous larvae) a short coronal suture and other features indicating a greater degree of specialization than the larval *Protoplasa* exhibits in its head structures, and there is no doubt that *Protoplasa* is very much more primitive than any Bibionid; but none the less, a larval Bibionid is of great interest in attempting to determine the character of the primitive Dipterous head, and cannot be ignored in such a study.

When the larvae of the Dipteron-like Mecopteron *Nannochorista* are discovered, they will doubtless be extremely similar to the larva of *Protoplasa,* particularly in the head region, but until these larvae have been found, we must do the best we can with the Mecopterous larvae available for study. Of these, the larva of the Mecopteron *Panorpa* shown in Fig. 30 furnishes the best prototype from which the *dorsal* structures of the larval head-capsule of primitive Diptera could be derived, while the larva of the Mecopteron *Boreus* shown in Fig. 32, will serve somewhat better for deriving the *ventral* structures of the head capsule of the primitive Diptera. A study of the mouthparts of larval Trichoptera is likewise very instructive in this connection, while features encountered in the head capsule of larval Lepidoptera and Neuroptera are also of value (particularly in the arrangement of the setae, etc.). The head-structures of larval Mecoptera and Trichoptera are so suggestive of the prototypes of the Dipterous structures that we must assume that the common ancestors of the Mecoptera and Trichoptera were the forms from which the Diptera were derived, instead of assuming that the Mecoptera alone are the nearest representatives of the ancestors of the Diptera.

Within the order Diptera, the larvae of the Chironomidae are as much like the larvae of *Protoplasa* as any I have seen, in the general appearance of the body, with its pair of posterior "pseudopods," etc., and this might be interpreted as lending some support to the views of Lameere, who grouped together the Culicoids (including the Chironomids) and Psychodoids (which include the Tanyderids), or the view of Edwards who maintains that the Psychodoids (including the Tanyderids) gave rise to the Culicoids (including the Chironomids) ; but the details of the head structures, etc., of the larva of *Protoplasa* are not sufficiently similar to those of a Chironomid larva to demonstrate this satisfactorily. On the other hand, the larval structures do not seem to lend much support to the evidence of rather close relationship between the Ptychopteridae, Tanyderidae and Psychodidae (with *Nemopalpus* and *Bruchomyia*) indicated by the thoracic sclerites (see Vol. 37, p. 33, of the Entomological News for 1926), nor do the larvae lend much support to the view of Edwards that the Blepharocerids were descended from Tanyderid forebears (see also thoracic resemblances between the adults mentioned on p. 63 of Vol. 19 of the Annals of the Entomological Society of America for 1925), and it is a question as to which stages we shall consider the most important, in grouping insects according to their larval, pupal or adult characters.

While I would emphasize the fact that no source of information should be ignored in attempting to arrange the orders and families, etc., of insects according to their natural affinities (i. e., phylogenetically or genealogically) I am inclined to give greater weight to the evidence of relationship furnished by the structures of the adult insects in such a study, for the following reasons. The larval stages are usually very plastic and are evidently profoundly modified in adaptation to their own individual (specific) environmental conditions, becoming in this process extremely modified away from the main evolutionary trends which are followed more conservatively by the adults. In other words, the larvae present many "sidewise" developments or caenogenic modifications having no real evolutionary significance and frequently representing individual (specific) adaptations each to its own peculiar environmental conditions. They thus frequently present broken series of isolated types not intergrading through closely connected intermediates as is more frequently the case when the adults are studied, and because of this fact, the evidence of the adult structures is much more satisfactory for arranging the groups according to their natural affinities. I realize that in some cases, such as the classification of Culicids on the basis of larval structures, the study of the larvae pointed the way for a better arrangement of the groups than had been employed in arranging them according to the trivial characters used in the classification based upon the adults alone. In this case, however, the details of structure had been better studied in the larvae, while the structures of the adults were practically unknown to the students of the group who fastened their attention upon such trivial characters as the hairs and setae and what not, to the neglect of the really fundamental features, upon which any real knowledge of relationships is based. In fact it is usually the case that a student of one group of insects does not know the entire anatomy (external) of any insect in that group and knows but little of the comparative anatomy of the general features of the adults, with the result that he frequently does not know what is fundamental or really important in contrast to the trivial features having but little significance for indicating true relationships. On the other hand, some of the accepted views regarding the arrangement of the families, orders, etc., are quite superficial or erroneous, and there is a great need of a thorough study of the comparative anatomy of adult insects as well as the comparative anatomy of the immature forms to serve as a check on the findings based upon the study of adults alone.

A phylogenetic or genealogical study of insects should not be limited to the study of the relationships of the families within an order of insects, but should be of such a character that it can likewise be applied to the grouping of the orders themselves according to their natural affinities, and the same kind of evidence should be used in both cases, the evidence for the grouping of the orders being merely more comprehensive or inclusive, instead of being of a wholly different character from that used in grouping the families. When we adopt this broader viewpoint in grouping insects in the general scheme, it at once becomes apparent that the larval characters are of much less value than the adult ones. Thus, for example, we are unable to compare the larvae of even the lowest Holometabola (which are still very different from the corresponding adults) with the immature stages of the Psocoid and Orthopteroid forms (which were like the forebears of the Holometabola) since the immature stages of the Orthopteroids, etc., are essentially like the adults; and it is therefore necessary to compare the adult Holometabola with the mature Orthopteroids in order to get the intermediate stages indicating the paths of development followed in deriving the Holometabola from their Orthopteroid precursors. Thus when we work up from a comparison of the orders of Orthopteroid insects to a comparison of the orders of Holometabolous insects and from this to a comparison of the families within these orders (using the same kind of evidence) it is impractical to use larval characters, and the real importance of the adult characters is impressed upon the student having the wider viewpoint (and supposedly with a better background to enable him to determine what is really primitive or fundamental when he attempts to apply his knowledge to the smaller groups also).

While giving greater weight to the adult characters, it would be folly to ignore the evidence of relationship available from any other source (even palaeontology, embryology, ecology and behavior, etc., should be called upon for testing the views based upon the study of one type of evidence) but when the structures of the larvae confirm the evidence of relationship indicated by the structures of the adult insects we should feel that the views based upon this wider study are more sound. On the other hand when the larval structures offer no definite evidence of relationship, it is preferable to depend upon that furnished by the adult structures. The larva of *Protoplasa* is of such an isolated type that until we know more about the larvae of such forms as the primitive Psychodoids (e. g., *Nemopalpus* or *Bruchomyia*, etc.) we cannot definitely determine the closest relatives of the Tanyderids from the larval characters as well as we can from the adult features, such as the venation, etc., and in the present state of our knowledge it is not possible to do more than to indicate wherein the larval structures of *Protoplasa* confirm the evidence of relationship indicated by the structures of the adults.

Taking the dorsal view of the head of the larva of *Panorpa* shown in Fig. 30 as the prototype from which the larval head capsule of the Diptera was derived, we note that the coronal suture *c* is proportionately quite long (i. e., the stem of the Y-shaped epicranial suture is well developed), and the fact that the coronal suture *c* of *Protoplasa* (Fig. 13) is longer than that of the Bibionid larva shown in Fig. 31 indicates that the head capsule of the *Protoplasa* larva is more primitive in this respect. On the other hand, the frontal sutures *fs* of the Bibionid larva (Fig. 31) are more specialized in being much longer proportionately than the frontal sutures of *Protoplasa* (Fig. 13, *fs*) and those of the larva of *Panorpa* (Fig. 30, *fs*). In the Culicid larva shown in Fig. 33, the frontal sutures *fs* are greatly developed, and this likewise may be taken as a specialized feature, although the eyes *e* of the Culicid larva are compound, like those of *Panorpa* (Fig. 30, *e*) and are therefore more primitive than are the eye spots *e* of *Protoplasa* (Fig. 13).

The antennae *a* of *Protoplasa* (Fig. 13) are three-segmented and the proportions of the component segments are strikingly like those of the three-segmented antennae *a* of *Panorpa* (Fig. 30), and in this respect, the antennae of *Protoplasa* (Fig. 13) are much more primitive than those of the Culicid shown in Fig. 33, despite the fact that the antennae of this Culicid larva are very well developed. For some unknown reason, the antennae *a* of the Bibionid larva shown in Fig. 31 are reduced to the merest rudiments (as in some Trichopterous larvae) despite the fact that the head capsule of the Bibionid larva is quite primitive, and its mouthparts are very primitive for those of a Dipterous larva; but this feature of heterospecialization, or unequal specialization in different features of the body, is a very common phenomenon among insects, and in reconstructing the archetype or original condition of any body part, we have to combine the primitive features retained by several different insects instead of depending upon any one insect to present all of the primitive features in a condition approaching the original one.

The character of the labrum, *lr,* anteclypeus, *ac,* and postclypeus, *poc,* in the larva of *Panorpa* shown in Fig. 30 may be taken as representing the original condition from which these sclerites were derived in the Diptera, and in these features the Bibionid larva shown in Fig. 31 and Fig. 12 is fairly primitive, although the labrum *lr* is not clearly demarked in the Bibionid. The larva of *Protoplasa* shown in Figs. 8 and 13 is disappointingly specialized in this region of the head, since the labrum *lr* in more membranous than one would expect to be the case in such a primitive Dipteron. The epipharyngeal brushes or labrobrustia labelled *es* in Fig. 13, are borne on the epipharyngeal surface of the labrum and doubtless are used to brush the food into the mouth as the larva feeds. The posterior limits of the labrum in the *Protoplasa* larva are indicated by the tormae labelled *t* in Figs. 6 and 21 as in Orthopteroid insects, and there is also an " intertorma " or small median transverse sclerite resembling the " intertorma " described in *Stenopelmatus* (Pan-Pacific Entomologist, Vol. 6, p. 97, for 1930), since it lies just behind and between the tormae. The " clypeites " *cl* or sclerites in the anteclypeal region *ac* in the larva of *Protoplasa* (Fig. 8 and Fig. 13) are other Orthopteroid structures resembling those described in *Gryllotalpa* and *Cylindracheta* (Entomologische Mitteilungen, Vol. 17,

p. 252, for 1928) and I think that these " clypeites " form the anterior sclerites incorrectly called the " tormae " in the frontal views of the head capsule of adult Diptera by Peterson, 1916 (Illinois Biol. Monographs No. 2, Vol. 3, p. 177), because the tormae are always borne on the buccal surface (or "roof of the mouth"), while the " clypeites " are borne on the frontal surface of the head, and I think that this distinction is not a purely academic one, since the two types of structures are not actually homologous. The postclypeus *poc* in *Protoplasa* and the other larvae shown in Figs. 8, 13, 31, 30, etc., extends as far back as the imaginary line across from one frontal pit (or frontocava) *fp* to the other, and this postclypeus corresponds in a general way to the region called the epistoma in Coleopterous larvae, and may be used as a synonym for the latter term. Behind the postclypeus or epistoma *poc* of the larvae shown in Figs. 30, 31, 13, etc., is the frontal region *f*. Snodgrass, 1928 (Smithsonian Misc. Collections, Vol. 81, No. 3, p. 1) is inclined to use the muscle attachments for delimiting the posterior boundaries of the clypeus (or its posterior region the postclypeus), but I have followed Peterson, 1916 (l.c.), in using the frontal pits to demark the posterior limits of the clypeus, and have regarded the region behind the frontal pits *fp* (and bounded posteriorly by the frontal sutures *fs*) in Figs. 30, 31, 13, etc., as the frons. The curve in the frontal sutures *fs* near the frontal pits *fp* in the Bibionid and Tanyderid larvae shown in Figs. 31 and 13 is very like that of the frontal sutures *fs* in the larva of *Panorpa* shown in Fig. 30.

The nature of the thoracic sclerites of adult Ptychopteridae, Tanyderidae and Psychodidae (including *Nemopalpus* and *Bruchomyia*) indicates that these insects are quite closely related (see Ent. News for 1926, Vol. 37, p. 33) ; but the larvae that I have been able to examine do not bear out the relationship indicated by the adults, possibly due to the fact that such primitive Psychodids as *Nemopalpus* and *Bruchomyia* are known only from the adults, and if their larvae were found, they might furnish evidences of relationships not indicated by the specialized larvae I have seen. At any rate, the character of the anterior regions of the heads of the Psychodid and Ptychopterid larvae shown in Figs. 9 and 10 is no more suggestive of a Tanyderid larva (e.g., Figs. 8 and 13) than a Bibionid, for example (see Fig. 12), and until the more primitive larvae of these Diptera are found, we must depend largely upon the adult characters for determining the closest affinities of the Ptychopteridae, Tanyderidae and Psychodidae.

While the dorsal or frontal region of the head of a *Protoplasa* larva (Fig. 13) is more like that of a larval *Panorpa* (Fig. 30), the under or ventral surface of the head of *Protoplasa* (Fig. 6) with its peculiar labial plate *gm* and paragular sclerites *pg*, is more like the under side of the head of a larval *Boreus* (Fig. 32). On the other hand, the mandible of a larval *Protoplasa* (Fig. 3) with its mandibular brush *b*, and the mandible of the larval Bibionid shown in Fig. 5, with its mandibular brush *b*, are much more like the mandible of the Trichopterous larva shown in Fig. 7, with its mandibular brush *b* (see also certain Coleopterous larvae) than the mandibles of these Dipterous larvae resemble that of a *Panorpa* larva, for example (see Fig. 1). Why the mandibles of these primitive Dipterous larvae should resemble the mandibles of a Trichopteron rather than a Mecopteron is not clear (though if we had the larvae of the Dipteron-like Mecopteron *Nannochorista* its mandibles would doubtless be more like those of the Diptera in question).

As was mentioned above, the under side of the head of a *Protoplasa* larva (Fig. 6), with its broad labial sclerite *gm*, apparently homologous with the gular and submental regions (with the mentum also?) and its paragular sclerite *pg*, is more like the under side of the head of the larva of the Mecopteron *Boreus*, shown in Fig. 32 than it is like the head of the larval *Panorpa* shown in Fig. 19, because the larva of *Panorpa* has no demarked paragular sclerite and instead of having the typical labial plate *gm* of Fig. 6, the ventral halves of the head are approximated to form the suture *mg* (which was referred to as the " midgular suture " in the figure of a larval *Panorpa* shown in Fig. 19, Plate 3, of Vol. 14 of the Annals of the Entomological Society of America for 1921—but see discussion of this region in Vol. 20, p. 1 of the Journal of Entomology and Zoology, Claremont, Cal., for 1928, where the single median suture is interpreted as an epigular suture, since it is formed by the meeting of the lips of the folds lying upon the infolded gular region). The larva of the Psychodid shown in Fig. 23 has such a median gular suture, and is therefore not very like the larva of the Ptychopterid shown in Fig. 17, which is more like the Tanyderid larva (Fig. 6) in having a distinct basal labial sclerite. Some larval Leptocerid Trichoptera have a distinct basal labial sclerite, while other rather closely related larvae have an overgrowth of this region resulting in the formation of a single suture in this region (somewhat as in the larva shown in Fig. 22), and in some species of the genus *Hydropsyche,* for example, there are two gular sutures (with a broader sclerite between) while in other species of the same genus, there occurs an overgrowth of the gular region resulting in the formation of a single suture in this region, so that this feature is not one of importance in indicating the relationships, or lack thereof, between the Trichopterous larvae, and consequently should not be given much weight in studying the affinities of Dipterous larvae either.

The paragular region *pg* of Figs. 6, 21, and 15, of the larva of *Protoplasa,* is a very unusual structure, and resembles the sclerite I have referred to as the paragula in a Hepialid larva (Fig. 31, Pl. 4, Vol. 19, of the Annals Entomological Society of America for 1921) though the region labelled *pg* in the *Protoplasa* larva may possibly be connected with the cardo. The region labelled *st* in the maxilla of *Protoplasa* (Fig. 15) is probably the stipes, though it may represent the distal portion of the stipes *ds* of a Trichopteron larva (Fig. 22) if the basal region of the stipes is fused with the sclerite *pg* in Fig. 15. The lobe labelled *m* in the maxilla of *Protoplasa* (Fig. 15) is probably largely the galea, since the galea is the maxillary lobe best developed in the adult Diptera, but for the sake of convenience, I shall refer to it simply as the "mala," borrowing this usage from the Coleopterists.

In the Bibionid larva shown in Fig. 18, both the "mala" *m* and the maxillary palp *mp* are borne on a region traversed by a narrow sclerite labelled *s* in Fig. 18. This sclerite may be a part of the cardo (i.e., like the slender cardine sclerite labelled *ca* in the Neuropteron larva shown in Fig. 20), but I am inclined to consider that the slender sclerites labelled *s* in the Bibonid larva (Fig. 18) and in the larva of *Panorpa* also (Fig. 19) represent the slender sclerite of the stipes region labelled *s* in the Trichopteron larva shown in Fig. 22; and if this is the case, the cardo is obsolete in the larvae shown in Figs. 18 and 19. The composition of the maxilla of the Ptychopterid larva shown in Fig. 17 is more like that of the Bibionid larva shown in Fig. 18, than it is like the maxilla of *Protoplasa* (Fig. 15) or a Psychodid larva either, and the maxillae are rather disappointing structures for studying the affinities of Dipterous larvae. In fact the mouthparts in general do not furnish the clews to the relationships of the lower Diptera, or to their nearest relatives among the other Holometabola, that I had hoped might be the case. I simply cannot understand why the mandibles of *Protoplasa* (Fig. 3) should be more like those of a Bibionid (Fig. 5) and both of these like a Trichopteron larva (Fig. 7) when by all the adult indications, the Bibionid larva should lead back to an Anisopodid and thence back to a Trichocerid, and from this type to a Mecopteron, but the Bibionid mandible (Fig. 5) is not suggestive of that of a Trichocerid (Fig. 4), though the Trichocerid has tufts of hair suggestive of the prototype of the brush *b* of the Bibionid (but not in the right position to be the precursors of the brush *b* of the Bibionid), and the *Protoplasa* mandible (Fig. 3) is not like the *Panorpa* mandible shown in Fig. 1. In referring to the mandible of the larva of *Protoplasa* (Fig. 3) it should be noted that one of the seta labelled *l*, has become very scale-like (see *l* of Figs. 21 and 6 also), and is a prominent feature of the mandibular surface that may prove to be of some interest. The basal labial sclerite *gm* (Fig. 16) is rather peculiar, and the narrow transverse sclerites behind it appear to be connected with it beneath the membranous integument, so that although at first sight these narrow transverse sclerites appear to represent cervical sclerites, I am more inclined to regard them as portions of the basal labial plate *gm* in *Protoplasa* (Figs. 16, 21 and 6). It is disappointing that the true labial portion of the underlip, bearing the labial palpi, etc., is not sufficiently developed to be readily detected in *Protoplasa* since I had hoped that the larva would give some indication of the development of the labial palpi, which are the main features of the pupal underlip in *Protoplasa*. The larva of the Ptychopterid shown in Fig. 17, exhibits some indications of the development of the labial palpi in a rudimentary condition (i.e., like those of some Trichopterous larvae, such as the one shown in Fig. 22), and the larval Anisopodoids show traces of the labial palpi, but none of the Diptera have them as well developed as they are in the larva of *Panorpa* (Fig. 19) or in certain Trichopterous larvae, and those of other Holometabola. The labium of the Bibionid larva shown in Fig. 18, bears latero-dorsal extensions (*le* of Fig. 18) which are directed " mesad " and are hence not seen from the exterior. These appear to be of some interest for the interpretation of the parts of the labium in lower Diptera, but I have not as yet determined their homologies definitely, since I have not as yet been able to obtain the Trichopterous larval types which will probably aid in the identification of these structures in the Diptera.

In examining the distribution of the head setae in the larvae of lower Diptera and related Holometabola, it is noteworthy that in *Protoplasa* (Fig. 13) the setae near the frontal sutures *fs* seem to lie laterad of these sutures, while in the Bibionid larva shown in Fig. 31, and in the larva of *Panorpa* shown in Fig. 30, the setae near the frontal sutures *fs* are situated within (mesad of) these sutures, and in the larval Trichoptera this seems to be the case also. There is some dispute as to which sclerites of the larval head represent the clypeal region, the frontal region, etc. (the so-called adfrons of Lepidopterous larvae is considered by Snodgrass as a frontal region, while the so-called frons of these larvae is interpreted as the clypeus by him) and until the muscle attachment in these regions has been more thoroughly investigated in the larvae of lower Diptera, Mecoptera, Trichoptera, etc., and until more intermediate types of larvae have been compared together, it will not be possible to determine definitely the real homologies of the sclerites of this region of the head, so that a comparison of the setae of the head of *Protoplasa* with those of other larvae (particularly with those of the Lepidoptera) can be more advantageously studied later. I would point out the fact that the " frontal-pit setae " or " frontocaval setae " [i.e.,those in the neighborhood of the frontal pits *fp* (Figs. 13, 14, 12, etc.)] are very constant, and may be of especial interest in a comparative study of the setae of the various larvae. The setae of the thoracic region of *Protoplasa* will be compared with those of other larvae in a later paper, but I would mention at this time the pair of setae in the neck or presternal area just behind the transverse sclerites belonging to the basal labial plate (*gm* of Fig. 6), and also the groups of ventral setae labelled *as* in Fig. 6. The ambulatory setae *as* (usually in groups of three—occasionally four) may mark the region homologous with the legs of the pupal *Protoplasa*, but this is mere conjecture, and the interpretation of the areas about these setae must await further investigation.

The " pseudopods " or posterior, leg-like structures of the larval *Protoplasa* shown in Figs. 24 and 27 are of interest because they are very similar to those of a Chironomid larva. These posterior " pseudopods " of *Protoplasa* bear gills, labelled *gi* in Figs. 24 and 27, but the most interesting features are the sixteen lateral setae labelled *s* in Figs. 24 and 27, and the seven hooks labelled *h* in Fig. 27. When the muscles attached to the central region (represented by a central depression near the tip of the pseudopod in Fig. 24) contract, the lateral setae *s* are drawn together, and the hooks *h* of Fig. 27 come into play. I think that these hooks and setae are for creeping about, although the fan-like arrangement of the long setae (when expanded) suggests a swimming function or a structure for leaping backward. In the two types of Chironomid larvae shown in Figs. 25 and 26, the hooks *h* of Fig. 25 are replaced by the seta-like structures *s* of Fig. 26 (all of these setae were not drawn), and this suggests that the hooks are modified setae (or *vice versa*). The pseudopods of the larvae of *Protoplasa* and the Chironomids are more nearly alike than is the case in any other Dipterous larvae I have seen, and this may be taken to indicate that the Chironomids were derived from *Protoplasa*-like forebears, but I am not yet ready to give up the idea that most of the Nematocerous Diptera (other than the Psychodoids—Ptychopterids, Tanyderids and Psychodids—and the Tipulids) were derived from *Anisopus*-like ancestors leading back to the Tanyderidae, although it must be admitted that this derivation is based for the most part on adult characters alone (but a comparative study of the more inclusive groups, such as the orders, etc., has indicated that the adult characters are the most reliable and important).

I have not been able to determine the homologies of the "pseudopods" of *Protoplasa* (Figs. 24 and 27) although Dr. Alexander has suggested to me that they are homodynamous (serially homologous) with the crochet-bearing abdominal "pseudopods" borne on abdominal segments three to seven (inclusive) in the larva of the Tipulid *Dicranota* described by Miall, 1893, on page 235 of the Transactions of the Entomological Society of London for 1893. These "pseudopods" are strikingly similar to those of Lepidopterous larvae, and are probably homologous with them, and if the posterior "pseudopods" of *Protoplasa* are homologous with these, the posterior "pseudopods" of *Protoplasa* doubtless represent the larval "postpedes" of caterpillars. In examining the terminal structures of a larval Tipulid such as *Eriocera* (Fig. 29) it occurred to me that the ventral pair of posterior processes, which bear long setae as shown in Fig. 29, might be homologous with the posterior "pseudopods" of *Protoplasa*, and this possibility should be further investigated with a view to bringing these ventral processes with their setae, into line with the posterior "pseudopods" of *Protoplasa* and the abdominal "pseudopods" of *Dicranota.* There are also protrusile, seta-bearing structures borne at the end of the abdomen in Psychodid larvae, but I do not think that these can be brought into line with the other structures mentioned above. On the other hand, a systematic study of the terminal abdominal structures of larval Diptera should lead to some interesting results, and would apparently lend support to the view that Psychodid larvae (with their cylindrical posterior structures) are like the prototypes of the larvae of Dixids, Culicids, etc., and on this account would be of considerable importance from the standpoint of the phylogenetic arrangement of the Dipterous families. I am hoping to be able to complete my series of larvae illustrating the comparative anatomy of the terminal abdominal structures in the near future.

Abbreviations.

a....Antenna.
ac...Anteclypeus (anterior region of clypeus).
as...Ambulatory or podal setae.
b....Brustia or gnathobrustia (homologous with prostheca?).
c....Coronal suture (stem of epicranial suture).
ca...Cardo.
ce...Condyle of mandible (gnathocondyle).
cl...Clypeal sclerites (clypeites).
ds...Dististipes (distal region of stipes).
e....Eye, larval eyes.
es...Epipharyngeal brushes (labrobrustia).
ex...Extensor tendon of mandible.
f....Frons or front.
fl....Flexor tendon of mandible.
fp...Frontal pits (frontocavae) marking position of anterior arms of tentorium.
fs...Frontal sutures (arms of epicranial suture).
g....Ginglymus.
gi...Gill.
gm..Labial sclerite (gulamentum or postlabium).
gu...Gula.
h....Hooks of pseudopod.
i....Incisors of mandible.
l....Mandibular scale (gnatholepis).
le...Dorso-lateral extension of labium.
lr...Labrum.
lp...Labial palpi.